

# Human factors and ergonomics to improve performance in intensive care units during the COVID-19 pandemic

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## Abstract

The COVID-19 pandemic has tested the very elements of human factors and ergonomics (HFE) to their maximum. HFE is an established scientific discipline that studies the interrelationship between humans, equipment, and the work environment. HFE includes situation awareness, decision making, communication, team working, leadership, managing stress, and coping with fatigue, empathy, and resilience. The main objective of HF is to optimise the interaction of humans with their work environment and technical equipment in order to maximise patient safety and efficiency of care. This paper reviews the importance of HFE in helping intensivists and all the multidisciplinary ICU teams to deliver high-quality care to patients in crisis situations.

**Key words:** COVID-19, pandemic, intensive care, human factors, resilience, leadership.

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The COVID-19 pandemic has stretched health care resources to the point of crisis worldwide. It is considered the worst global emergency since World War II and has intensely shaken health systems, economies, and societies. The pandemic began in China back in December 2019 with rapid and extensive international spread, and a mortality rate of more than three million people to date, overwhelming hospitals, mortuaries, and cemeteries. The short-term impact on people takes the form of anxiety about health and livelihoods, and restrictive adjustments. Healthcare workers also carry the physical and psychological burden of working through further pandemic peaks having experienced the first wave. Although there has been growing recognition of the importance of human factors (HF), skills and ergonomics in delivering high quality care in the complex environment of the intensive care unit (ICU), the pandemic has sharply accelerated their application.

## OBJECTIVES

The objectives of this paper are threefold. The first is to increase the general awareness of the importance of HF in the patient journey through critical care and in crisis situations, to ensure *genuine* multidisciplinary collaboration and hence patient safety and 'care client' [1] experience. Studies on doctor-patient relationships have shown that position, status, power, control and ego increase patient dependency on and fear of healthcare personnel. Research further suggests that the patient's perception of the doctor-patient relationship has a psychological as well as measurable physiological impact, such as higher blood pressure (white coat syndrome), shallow breathing and perspiration. The word 'patient' is used by healthcare staff to confirm a relationship of power and position (from the doctor's perspective), and a relationship of dependency (from the patient's perspective).

As such, both sides continue with their behaviour, which has a clear negative impact on the patient's perception and well being. Language has been known to be an important parameter in behavioural change. We would therefore suggest making a distinction between 'patient' and 'care client'. The word 'patient', in fact, refers to full dependency on the 'healthcare expert'. The term 'care client' signifies an autonomous individual with unique skills and abilities, an independent view on his/her body and in some cases, detailed knowledge about his/her own medical condition(s). Like a doctor the care client is also an expert. Healthcare teams use a balanced communication strategy when they choose technical language while talking to each other ABOUT the patient, they use simpler terms and explain medical jargon when they communicate WITH patients, and they never talk OVER the patient. Research additionally shows that patients who feel comfortable as a patient or care client collaborate more constructively, which has a positive effect on patient safety but also on the healthcare staff's well-being [2]. Our key message is therefore to involve the patient/client in the decision-making process, adopting a less paternalistic view.

The second objective of this paper is to name and define the skills that give meaning to the concept of HF. Applying HF in a medical context is not a choice from a menu of HF principles. These skills are closely interrelated and interdependent. It is the well-known (by instructional psychologists) *learning steps approach* of (1) awareness, (2) knowledge and insight, (3) application and (4) integration of the *holistic* picture of the interrelated and interdependent HF skills that will account for its success. We define success in the context of this paper as a consistent change in behaviour of staff members involved during a crisis. Entire teams must apply the holistic HF principles for organisational culture to change [2]. And that is the biggest challenge any organisation is confronted with, be it hospitals, schools, government institutions, family businesses, or multinationals. Achieving a permanent and pervasive change is the biggest challenge for any organization. Culture in the context of this paper is defined as the sum of the individual behaviours shown by every employee in an organisation or in a department. Individuals vary in their HF skills disposition and abilities. Even in the ideal setting, e.g. conducive culture with good leadership, a proportion of staff members may still find that HF skills learning and application do not come naturally. Unfortunately, the traditional style of medical training tended to focus on the rational, scientific, Cartesian way of thought and action. Increasingly, there is greater emphasis on softer skills, particularly com-

munication, often delivered in an educational module on the doctor-patient relationship. But a stand-alone module on human behavioural skills does not have any effect in changing daily interaction with patients.

The third objective of this paper is to describe the conditions required to institute behavioural change in all staff members, and hence cultural change at the hospital level [2]. The gap between intention to change and widespread integration of HF principles into daily practice is considerable. Education, strong inspirational leadership and constructive reviews are crucial, though a top-down approach is unlikely to be sufficient. A sea change can only be brought about if the individuals believe in and embrace HF skills as a genuine component within their own practice.

## DEFINITIONS

Human factors and ergonomics (HFE), also known as non-technical skills (NTS), was first studied in the aviation industry 40 years ago after research suggested deficiency in NTS to be a contributory factor in fatal accidents. It is now recognized in healthcare to be as important in patient safety as technical knowledge and clinical expertise [4]. It is an established discipline which studies the interrelationship between humans, equipment and the work environment to maximize patient safety and work efficiency. HF comprises situation awareness, decision-making, communication, team working, leadership, empathy, resilience, managing stress, and coping with fatigue [5, 6]. Additionally, we propose that it encompasses these key concepts: agility, serendipity, innovation and learning [2]. We will briefly define the various HF skills and behaviours.

### Situational awareness and decision making

Situational awareness (SA) is the perception and interpretation of environmental elements and events, the comprehension of their meaning, and the projection of their future status [7].

Decision-making (DM) is the process of choosing a course of action in a scenario that offers multiple alternatives [6]. These skills, which can be taught through simulation training, are crucial to managing a disruptive or unexpected emergency, by helping to identify key information so as to make clinically appropriate and timely decisions.

During the COVID-19 pandemic, these skills were utilized in the re-construction of ICUs and the redeployment of healthcare workers from different specialities into surge ICUs. The 'surge COVID-19 team' made it possible to rapidly increase bed capacity to

cope with increased admissions. A multi-disciplinary collaborative approach facilitated the making of difficult decisions regarding escalation of care from ward level to mechanical ventilation and withdrawal of care when treatment became futile [8].

### **Empathy**

Empathy consists of the ability to understand and share the feelings of another. Expressing empathy is highly effective and powerful; it builds patient trust, calms anxiety, and can improve health outcomes. Empathy towards co-workers is also a key skill in the workplace. It can help in resolving conflicts, in building more productive teams, and it contributes to the improvement of the relationships among colleagues.

### **Agility**

Agility is the power of moving quickly and easily; it is nimbleness and lightness. Agility is the ability to rapidly think and draw conclusions, based on intellectual acuity [2].

### **Serendipity**

Serendipity is the occurrence and development, by chance, of events in a happy or beneficial way. It is the concept of being innovative by finding solutions that were not originally being sought [2].

### **Learning**

Learning in this context refers to the ability to change one's own behaviour and facilitate change in behaviour in others based on previous mistakes or failures or based on successes of other teams or organisations in similar conditions [2].

### **Leadership and leading by example**

Leadership is defined as the ability to lead, guide and mentor, specifically considering the needs of each team member. Efficient teamwork requires clear communication so as to achieve the goal. Leaders who successfully steer the team through a crisis are often characterized by decisiveness, maturity, compassion and emotional intelligence, with the ability to inspire optimism and trust in their colleagues [3]. Apart from their clinical and administrative duties, which are clearly set, good leaders also provide support in an intangible form. In the context of the COVID-19 pandemic for example, an effective leader does not just arrange supplies of personal protective equipment (PPE), but also considers the welfare of staff, e.g. adequate accommodation, available childcare and mental health support. He/she helps the team members to feel safe during a pandemic and may take on additional tactical support tasks, e.g. organising meals and

staff cover when breaks are required, and most importantly, a leader identifies and compassionately supports team members who are struggling/excessively self-critical [6, 8].

### **Resilience**

Resilience is defined as toughness, flexibility and the capacity to recover after facing difficulties; it is the process of bouncing back in the face of adversity [9]. The five key resilience skills are self-awareness, attention, flexibility and stability of focus, letting go (both physically and mentally), and maintaining positive emotion. The COVID-19 crisis has demanded self-awareness and resilience from healthcare professionals, in order to physically, mentally and emotionally cope under extreme working conditions [2]. However, if resilience reflects a process of 'bouncing back' from difficult circumstances, both individual and environmental factors need to be considered. There needs to be consideration for the environment people are bouncing back into, rather than just focusing on the 'bounce' ability of individuals. Apart from self-care measures that can improve the individual's resilience, workplace well-being initiatives such as mindfulness, counselling and free refreshments can also help staff to feel valued and cared for [10]. Whilst the personal resilience of staff members is an important priority, it is the employer's responsibility to ensure that the 'healthcare system' is also resilient – this entails the provision of sufficient resources to meet the current healthcare demand. Organisational resilience can help reduce the incidence of burnout and ensure sustainability of the workforce, the value of which cannot be over-emphasized during a pandemic [11].

### **Communication**

Communication is the exchange of information between people. It is a pillar to teamworking, which is the process of working collaboratively to achieve a common goal [6]. Face-to-face communication during the pandemic poses a constant challenge, primarily because of the physical barrier created by PPE, and also because of social distancing regulations. Physical barriers aside, in such a stressful situation, diplomacy might cease, leading to potential conflicts among staff. Daily briefing sessions and follow-ups of the activities have proved instrumental in facilitating shared problem-solving [12]. Schwartz Rounds (and the recently adapted online 'Team Time') provide a structured forum where all staff, clinical and non-clinical, regularly gather to discuss the emotional and social aspects of working in healthcare. The purpose is not to focus on patient care nor solve problems, but rather to understand the challenges and rewards that are intrinsic to providing care [13].

### **Training and simulation to enhance patients' safety**

HF play an important role in improving patient safety; NTS training and assessment are of great importance within healthcare education. Simulation-based teaching on human factors and ergonomics has been successfully used in healthcare over the last decade. Its wider use and importance have never been as relevant as they are during the COVID-19 outbreak. The rapid onset of this pandemic placed a huge burden on all resources, including workforce, equipment and locations, and required co-ordinated actions. Simulation plays a pivotal role in the implementation of these processes by identifying and mitigating barriers, both from patients' and staff's safety perspective [14]. Different simulation techniques include: 1) just-in-time (JIT) training: focused on education and with the purpose of training as many as needed into new positions (ideal for surge staff), 2) system-focus simulation: to understand and optimise adaptive workflow and processes, and 3) person-focus simulation: to help supporting healthcare professionals in dealing with the emotional strain of the situation [14].

Virtual reality or augmented reality simulation and telesimulation are unique simulation modalities that consider the need for social distancing; therefore, they have come into the spotlight during the COVID-19 outbreak. Simulation has the potential of improving team cognition, it contributes to improved communication while wearing FFP3 masks, and it cements teamwork and team situational awareness [15]. Simulation training also contributes to reduction of fatigue and enhancement of stress handling coping mechanisms [16].

### **OUR RECOMMENDATIONS – LEARNING POINTS**

The COVID-19 pandemic has tested the very elements of HFE to their maximum. In the aftermath and when COVID-19 cases slow down, it is essential to use HFE approaches and methods to learn from failures and successes, and globally share these lessons to minimize the impact of future outbreaks. We recommend integrating HFE approaches across health care systems and involving NTS expertise at all levels of crisis management, from preparation and planning to execution and investigation [17].

We want to elaborate further with our lessons learned.

#### **The biggest challenge is culture and therefore individual behaviour**

In the face of the COVID-19 crisis, governments have taken drastic and dramatic measures to slow down the spread of the virus. These measures required immediate behavioural changes from all of

us. Behavioural change is difficult because if people are not directly affected by mental or physical pain, they will not be inclined to change their behaviour. Moreover, to justify the unwillingness for change we usually say: "we have always done it this way". Leaders can help by being role models and providing direct feedback in a respectful way. Giving an example is like a virus: it spreads quickly. A "cultural broker" can help with behavioural change. Through analysis of leadership literature in crisis situations, we were inspired by the 2010 Chilean mine rescue [18, 19]. We elaborated some suggestions: 1) explain the current situation and the desired future to your team, and clarify how to get there, aiming to write a fluent connecting story; 2) use a single line of command (SLOC); 3) shift from an orderly and sequential process to a dynamic and iterative process; 4) involve your team at every step: creative teamwork is necessary for continuous innovation; 5) be open and honest, but don't panic; 6) be humble and listen to others' point of view.

#### **The best vaccine is courageous and decisive leadership**

In the pre-COVID-19 era hospital structures, internal politics, complicated relationships and egos could have been breeding grounds for intra-hospital conflicts. Such organizational cultures prevent agility and rapid implementation of adaptive strategies. Innovation and learning are hence essential in managing a pandemic. How did we tackle this in the ICU? 1) It started with us being the first to change: we evolved from an obsessive focus on separating COVID and non-COVID patients to becoming aware that we could all get the virus. With this insight, we afterwards lived by our mantra: "protect yourself in order to protect others and be careful with PPE". 2) Accept a two-speed approach within your organisation: in the ICU we were 2-3 weeks ahead compared to the rest of the hospital. 3) Choose the right people: for example, the SLOC should not be authoritarian or democratic, but should be adaptive. 4) Cognitive dissonance is the fuel of cultural change, so embrace this.

To put it bluntly, this crisis may not have lasted long enough, nor seriously affected enough young people, to produce a more or less constant change in behaviour among citizens, politicians and health care providers. Collective and individual leadership is needed at all levels, from boards of directors, management and medical councils to doctors, nurses, pharmacists, physiotherapists and cleaning teams. However, the current organizational culture in hospitals does not allow this; power, position, status control and egos stand in the way of much-needed changes in the healthcare sector.

## Human and medical disruption

The COVID-19 lockdown has disrupted our lives in many ways. This crisis is not only a deeply human tragedy but also a logistical nightmare. Virologists and epidemiologists have guided us well, but uncertainty has affected us all. The politicians have to lead the way, knowing that leadership starts where expertise ends. Some politicians did well, while others failed miserably. We noticed some concerning points: 1) as the lockdown measures were relaxed, the politicians believed they gave citizens the freedom to assume their responsibilities. But because the citizens were not part of the decisions, they had no intrinsic voluntary motivation. 2) Citizens generally do not want to be patronized. Equally, all of us also have blind spots. For these reasons, individual leadership is about our responsibility to give perspective and hope to our neighbours and employees; in contrast, complaining and fear are a waste of valuable energy. 3) Clear and transparent communication is essential. 4) Leaders who speak with one voice increase people's confidence and help them follow the rules.

## No individual leadership can exist without collective leadership

Hospitals are focused on how they can remain functional in this 'new normal'. Resilience is required for this; and humanity has proven that flexibility, agility, rapid innovation and fast learning are part of its DNA. Resilience of both organizations and individuals is essential to achieve sustainable growth. Facilitating resilience requires a clear vision, a jointly developed strategic implementation plan ('a story that connects the dots'), a strong leadership and an open and transparent culture. However, we are starting to see that there is no new normal; it will soon be business as usual again (for example, we need to run elective surgeries, while we treat COVID-19 patients in ICUs).

In today's world, the "patient journey" and the "employee journey" are the gateway to sustainable growth in hospitals. But why are these journeys so difficult to achieve? And where do they meet? The vertical and hierarchical structure of organisations prevents these "journeys" from happening. The current hospital structure may be strong in terms of execution, but it is very slow in innovation and change. Now, agile execution power, rapid innovation and fast learning are exactly the key to implementing patient and employee journeys.

## Hospital networks: it is not what it is, it is what you do with it

The ways hospitals are financed today in many countries require urgent attention and call for a dif-

ferent approach. There is still a lot of inefficiency, overconsumption and overcapacity, especially in developed countries, while there is undercapacity in other parts of the world. Organizing the existing departments – which function in many hospitals as silos – more efficiently is not the solution. Nor is stubbornly trying to keep all medical disciplines in every hospital. The current – and outdated – hospital model is not only a matter of phasing out, but also of reorientation. Lack of a balanced and fair model is just one example: big earners will have to show more solidarity with health care providers who earn less. But until now it has been very difficult to gain transparency in this, while society demands it. These are uncertain and difficult times – and they require courageous and decisive leadership. We all have to put on our masks, but the masks of many might fall off. And this happens at all levels and within many organizations: in hospitals, care homes for the elderly, at the political level, the European level and the global level. With more than one million deaths from COVID-19 worldwide, hardly a single country can say that it has handled the crisis well. A suggestion? Maybe it is time for hospital networks to finally play a significant role at the national level – as long as they do not continue with business as usual, but thoroughly reform their structures and ways of working and genuinely start cooperating with each other. As a result, more patients will be provided with quality care and the problem of the shortage of healthcare staff on the floor can be solved.

## CONCLUSIONS

In retrospect, and looking at rough data on incidence and mortality rates, we have poorly managed this crisis. Maximum capacity in our ICUs was sometimes exceeded, despite draconian measures. The COVID-19 crisis has resulted in huge financial direct and indirect costs. Moreover, our healthcare system was already fragile before the pandemic. The system may be just good enough to handle another wave, but it is not sustainable in the long run. The applause for the people on the front line is more than deserved but misses its target, because it does not apply to everyone involved in the healthcare sector and excludes patients. And finally, politicians in many countries have missed a once-in-a-lifetime opportunity to show decisive, courageous and empathetic leadership. Another COVID-19 wave may give them a second chance. We want however to remain optimistic and believe that the stress and strain of the pandemic has upset the status quo of rather rigid healthcare systems to embrace a human factors approach. Recognition of the importance of human factors in critical care is the crucial step in facilitating both the "patient journey" and the "employee journey".

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